

REMARKS

As of the filing of the present Office Action, claims 1-24 were pending in the above-identified US Patent Application.

In the Office Action, the Examiner withdrew all previous rejections of the claims, but then rejected all of the pending claims on new grounds under 35 USC §103. In response, Applicants have amended the claims as set forth above. More particularly:

Independent claim 1 has been amended to incorporate the “releasing means” previously recited in its dependent claim 15, rename the “control system” as a “control unit” to avoid confusion with the system recited in the claim preamble, and recite functional aspects of the control unit that find support in Applicants’ specification at paragraphs [0041] and [0044]-[0045].

Dependent claim 5 has been amended for clarity.

Independent claim 8 has been amended to require that the silicon columns are “crystalline” and have “silicon surfaces with dangling bond sites,” as taught in Applicants’ specification at paragraphs [0067] and [0069].

Dependent claim 9 has been amended to recite one of two limitations found in claim 10.

In view of its limitations being incorporated into claim 1, claim 15 has

been amended to depend from independent claim 8 and recite a "control unit" similar to that now recited in claim 1.

In view the amendment to their parent claim 15, claims 17 and 18 have been amended to depend directly from claim 1.

Dependent claim 18 has been amended to recite a limitation that finds support in Applicants' specification at paragraph [0058].

Dependent claim 20 has been amended to more accurately recite that the porous silicon is formed in a silicon wafer.

Dependent claim 22 has been amended to use the term "deposition" instead of "electrodeposition," the latter of which is unnecessarily narrow since it is well known that other deposition techniques can be used to deposit noble metals.

New dependent claim 38 has been introduced that depends from independent claim 1 and recites the limitation of claim 15 (which depends from independent claim 8).

Finally, new dependent claims 39 and 40 have been introduced to recite a functional aspect of the control unit that find support in Applicants' specification at paragraphs [0054], [0059], and [0061].

Applicants believe that the above amendments do not present new

matter. Favorable reconsideration and allowance of claims 1-24 and 38-40 are respectfully requested in view of the above amendments and the following remarks.

Independent claim 1 and its remaining dependent claims 2-6 and 19-24 were rejected as unpatentable over U.S. Patent No. 4,265,720 to Winstel in further view of U.S. Pat. No. 5,882,496 to Northrup et al. (Northrup) as evidenced by U.S. Patent No. 5,926,711 to Woo et al. (Woo), claim 7 (which depends from claim 1) was rejected as unpatentable over Winstel, Northrup and Woo in further view of U.S. Patent No. 5,196,377 to Wagner, and claims 17 and 18 (which depend from claim 1) were rejected as unpatentable over Winstel, Northrup and Woo in further view of U.S. Patent No. 5,360,461 to Meinzer. Applicants respectfully request reconsideration of these rejections in view of the amendments presented above as well as the following comments.

Winstel discloses an "operative valve control means 6 . . . for charging and discharging of hydrogen" from a container 4, and represents the "valve control means" 6 in FIG. 2 as being manually operated. In contrast, the "control unit" now recited in amended claim 1 provides functionality neither taught nor suggested by Winstel. Yet another functionality of the control unit

is now recited in new dependent claim 39 (which depends from claim 1) that is lacking in the teachings of Winstel.

The Examiner cited Northrup as the basis for modifying Winstel to have a porous silicon structure, and specifically for disclosing “a porous silicon structure that is formed by electrochemically etching a crystalline silicon substrate or wafer ‘10’ with a hydrogen fluoride solution.” The Examiner stated that “[t]he process of etching the surface of the silicon layer inherently forms interior and exterior surfaces.” This is simply not correct; silicon etches are generally isotropic and therefore do not form pits or interior surfaces required by Applicants’ claim 1. Even silicon etches that are preferential for certain lattice planes do not form pits or interior surfaces. From Figures 3A and 3B of Woo it is evident that, though cited for disclosing “the process of wet etching the surface of a silicon film with HF . . . to form a bare silicon surface such that hydrogen bonds to the surface of the silicon film in dangling bond type,” Woo’s bare silicon surface is also not an interior surface. In contrast, electrochemical etches under certain operating conditions, such as those taught in Applicants’ specification (for example, see [0049]), are capable of forming interior surfaces in a silicon surface, and prior art such as Northrup and Woo that do not expressly disclose an etching process that forms interior

surfaces and pits within a silicon substrate cannot be arbitrarily assumed to do so.

Wagner and Meinzer were not applied as teaching anything in regard to the above differences between the system recited in Applicants' claim 1 and the combination of Winstel, Northrup, and Woo. Furthermore, while Meinzer was cited for teaching a light source that emits photon energy to release hydrogen from a hydrogen storage bed, Meinzer does not teach or suggest transmitting photon energy through a porous silicon and onto interior surfaces within the porous silicon to release chemisorbed hydrogen atoms, as required by claim 18.

In view of the above, Applicants respectfully believe that the combination of Winstel, Northrup and Woo and any combinations thereof with Wagner and Meinzer do not teach or suggest the system recited in Applicants' claim 1, nor any claims depending from claim 1. Applicants therefore respectfully request withdrawal of the rejections of claims 1-7 and 17-20 under 35 USC §103.

Independent claim 8 and its dependent claims 9 and 11 were rejected as unpatentable over Winstel in view of U.S. Pat. No. 7,135,057 to

Kornilovich and in further view of Northrup and Woo, claim 10 (which depends from claim 8) was rejected as unpatentable over Winstel, Kornilovich, Northrup, and Woo in further view of U.S. Patent No. 4,594,229 to Ciszek et al. (Ciszek), claims 12 and 13 (which depend from claim 8) were rejected as unpatentable over Winstel, Kornilovich, Northrup, and Woo in further view of U.S. Published Patent Application No. 2002/0172820 to Majumdar et al. (Majumdar), and claim 14 (which depends from claim 8) was rejected as unpatentable over Winstel, Kornilovich, Northrup, and Ciszek in further view of U.S. Patent No. 6,040,230 to Anthony et al. (Anthony). Applicants respectfully request reconsideration of these rejections in view of the amendments presented above as well as the following comments.

Kornilovich consistently and repeatedly cites three features that are significant and contrary to Applicants' invention recited in claim 8. First, Kornilovich teaches that the storage medium is for neutral/molecular hydrogen (H_2 molecules), and not elemental (monatomic) hydrogen as taught and claimed by Applicants. Second, the neutral/molecular hydrogen is stored on functionalized organic molecules on the exterior of the silicon nanowire (column), and not on a silicon surface as required by Applicants' invention recited in claim 8. Third, Kornilovich teaches that the neutral/molecular

hydrogen is absorbed by physisorption, and not chemisorption as taught by Applicants. Emphasis on “neutral hydrogen,” “functionalized,” “organic molecules,” and “physisorption” can be found throughout Kornilovich. Because silicon does not physisorb neutral hydrogen, Kornilovich’s use of silicon is unnecessary, as acknowledged at [0009] (“the nanowire core may be a silicon nanowire”; emphasis added). Accordingly, Kornilovich could just as easily have used any other nanowire material.

Finally, Applicants’ independent claim 8 requires crystalline silicon columns. Applicants have already argued, without any disagreement from the Examiner, that Kornilovich’s disclosed “silicon nanowire” is by definition periodic in one dimension only, and therefore not a crystal.

Ciszek was cited for teaching “the concept of forming a silicon crystal from a silicon melt such that the silicon crystal is oriented in the (111) plane,” citing “an improvement of the grain size of the resulting silicon crystal.” Because the Examiner has failed to establish that grain size is relevant to any of the technical aspects of Winstel, Kornilovich, Northrup, or Woo, Applicants believe Ciszek is an improper reference.

Majumdar was cited for teaching nanowires with diameters of 5 to 50 nm. Because Applicants’ silicon columns are not nanowires, Applicants

believe Majumdar is not relevant to their claimed invention.

Anthony was cited for teaching "polysilicon structures '306' that [are] etched with oxygen in order to roughen the surface," arguing that doing so will "enhance the surface area of the silicon columns and further improve the storage efficiency." Because the motivation for increased surface area is found only in Applicants' disclosure, Applicants believe Anthony is an improper reference.

Claim 15 and its new dependent claim 40, which depend from claim 8, recite a "control unit" having functionalities neither taught nor suggested by Winstel, Kornilovich, Northrup, Woo, Majumdar or Anthony.

In view of the above, Applicants respectfully believe that Winstel, Kornilovich, Northrup, and Woo and any combinations thereof with Majumdar and Anthony do not teach or suggest the system recited in Applicants' claim 8 or its current dependent claims 9-16. Applicants therefore respectfully request withdrawal of the rejections of these claims under 35 USC §103.

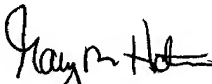
Closing

In view of the above, Applicants believe that the claims define patentable novelty over all the references, alone or in combination, of record.

It is therefore respectfully requested that this patent application be given favorable reconsideration.

Should the Examiner have any questions with respect to any matter now of record, Applicants' representative may be reached at (219) 462-4999.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Gary M. Hartman", with a stylized flourish at the end.

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